M12/4/BIOLO/HP3/ENG/TZ2/XX/M

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MARKSCHEME

May 2012

BIOLOGY

Higher Level

Paper 3

14 pages

General Marking Instructions

Assistant Examiners (AEs) will be contacted by their team leader (TL) through Scoris™, by e-mail or telephone – if through Scoris™ or by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader through Scoris™ or by e-mail at any time if they have any problems/queries regarding marking. For any queries regarding the use of Scoris™, please contact emarking@ibo.org.

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1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**

4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use Scoris™ annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.

5. Personal codes/notations are unacceptable.

6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an "NR" in the mark panel on the right-hand side of the screen.

7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. Scoris™ will only award the highest mark or marks in line with the rubric.

8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp "seen" on any page that contains no other annotation.

9. Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have got wrong. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the "CON" stamp.

Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options **[2 × 20 marks]**.
Maximum total = **[40 marks]**

1. A markscheme often has more marking points than the total allows. This is intentional.

2. Each marking point has a separate line and the end is shown by means of a semicolon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are underlined are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by ***OWTTE*** (or words to that effect).

8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking indicate this by adding **ECF** (error carried forward) on the script.

10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

Option D — Evolution

D1. (a) Limenitidinae ***[1]***

(b) large wing size / camouflage/cryptic coloration / warning coloration / mimicry / powerful wing muscles / high flight speed / erratic flight pattern / *OWTTE* ***[1]***

(c) (i)
a. natural selection favours survival of better-adapted individuals;
b. better-adapted butterflies have greater ability to escape predation;
c. and survive to reproduce;
d. allowing them to pass their characteristics/alleles/genes to offspring;
e. over generations, the number of butterflies with best-escaping ability increases in the population / frequency of alleles/genes for better escaping ability increases in the population/gene pool; ***[3 max]***

(ii)
a. palatable butterflies with high escaping ability can survive to pass on genes / palatable butterflies with low escaping ability are eaten and their genes are lost;
b. unpalatable/distasteful butterflies, regardless of escaping ability, are not eaten/are avoided by predators;
c. such butterflies survive to pass on their genes to the next generation; ***[2 max]***

D2. (a)
a. ^{14}C used to date more recent/up to 60 000 years old fossils;
b. ^{40}K used to date much older/older than 100 000 years old/up to millions of year old fossils;
c. proportion of fossil radioactive isotope compared to actual material using known rate of decay;
d. half-life of ^{14}C is 5730 years/relatively short while ^{40}K is 1250 million years/ relatively long; ***[2 max]***

(b) (i) (common) chimpanzee and bonobo ***[1]***

(ii) gibbon ***[1]***

(c)
a. named barrier;
b. description of its action;
c. results in terms of gene pools; ***[3]***

e.g.:
a. behavioural barrier;
b. different populations mate at different times of year thus preventing interbreeding;
c. allele frequencies become different in the two gene pools/separates gene pools / sympatric speciation;

D3. a. genetic evolution is dependent on genes/inheritance of alleles;
b. controlled by natural selection;
c. genetic evolution is limited by the genetic composition/genotypes of the populations;
d. requires generations/thousands of years for impact / *H. sapiens* has not changed much genetically since it appeared;
e. cultural changes passed on through learning;
f. large brains of *Homo* species allow more learning/cultural evolution / *OWTTE*;
g. cultural evolution is passing on traditions/language/religion/technology/other example;
h. cultural changes may occur in one generation/more rapid/faster cumulative effect than genetic evolution / most recent changes are cultural;
i. cultural changes such as medicine/genetic engineering reduce natural selection/ genetic evolution;
j. cultural changes such as pollution/radiation may increase mutation/genetic evolution; ***[6 max]***

Option E — Neurobiology and behaviour

E1. (a) first spawn/spawning ***[1]***

(b) a. frequency at full moon/E about the same;
b. both arrival (event) and amplexus (event) have low/similar frequencies in B and C;
c. highest frequency for arrival (event) in D whereas highest frequency for amplexus (event) in F;
d. always some arrivals but amplexus (event) only in B to F / no amplexus (event) in G/H/A; ***[2 max]***

(c) a. mass arrival (events) at phases D and E is followed by large amplexus (events) at phases E and F;
b. full moon/lunar cycle seems to influence timing of both events (in sequence) / *OWTTE*; ***[1 max]***

(d) a. example of environmental condition;
b. reason for the example; ***[2]***

e.g.:
a. rainfall;
b. necessary to maintain pond levels to enable the toads to spawn;

a. temperature / season / daylength;
b. affects metabolism / survival of offspring;

E2. (a) (i) (coordinates) unconscious motor functions/balance and movement ***[1]***

(ii) (maintains) homeostasis/thermoregulation/appetite/thirst / coordinates endocrine systems / secretes hormones/regulating factors ***[1]***

(b) a. several presynaptic neurons synapse with one postsynaptic neuron;
b. excitatory presynaptic neurons depolarize postsynaptic neurons whereas inhibitory presynaptic neurons hyperpolarize postsynaptic neurons;
c. some excitatory presynaptic neurons may not be able to depolarize/cause an action potential in the postsynaptic neuron alone;
d. usually many needed to cause postsynaptic transmission;
e. some inhibitory presynaptic neurons may block/cancel depolarization (in postsynaptic neuron);
f. postsynaptic action potential/response/decision making determined by summation of all signals; ***[3 max]***

(c) a. excitatory (psychoactive) drug;
b. effect at synapses in brain that use dopamine as transmitter;
c. inhibits receptors / binds to membrane proteins that pump dopamine / inhibits reuptake of dopamine;
d. causes build-up of dopamine in synaptic cleft/synapse;
e. causes continuous transmission at these synapses; ***[3 max]***

E3. a. altruistic behaviour is when one organism increases the risk of sacrificing/sacrifices its own life/reproductive success for that of another individual/the colony / *OWTTE*;
b. appears to be against natural selection;
c. (as it) reduces the possibility of the altruistic individual passing on its own genes;
d. (but) allows other individuals to pass on genes of the same gene pool;
e. if the altruistic allele persists in the gene pool then that trait can be naturally selected;
f. named organism and altruistic behaviour; { *(e.g. termites break a gland in their neck to release a sticky substance)*
g. benefit to others and risk to self; { *(e.g. protects others from attacking ants but kills themselves)*
h. another named organism and altruistic behaviour;
i. another benefit to others and risk to self; ***[6 max]***

*Award **[4 max]** if only one example of altruistic behaviour given.*

Option F — Microbes and biotechnology

F1. (a) $17\ g\ dm^{-3}$ *(accept answers in the range of 16.5 g dm^{-3} and 17.5 g dm^{-3})* ***[1]***

(b) a. concentration of xylose continues to increase while arabinose stays (approximately) constant;
b. concentration of xylose is always greater (than arabinose);
c. xylose concentration (appears to) stabilize at 50 hours while arabinose decreases slightly; ***[2 max]***
Do not accept answers stating numerical values alone.

(c) glucose decreases/is used up due to fermentation/anaerobic respiration (by yeast);
xylose increases due to (continued) hydrolysis/production;
xylose not fermented by yeast / apparently yeast enzymes do not ferment 5-carbon sugars; ***[3]***
Do not accept xylose increasing due to breakdown of glucose.

(d) widely available / relatively inexpensive / waste product of food production / non-competitive with food applications / sustainable / renewable ***[1]***

F2. (a) a. example;
b. change; ***[2]***

e.g.:
a. *Vibrio fischeri*;
b. emit light when part of high density population/high concentration of regulatory substance;
Accept other verifiable example.

(b) a. acids/lemon/vinegar/low pH;
b. high salt concentration;
c. high sugar concentration; ***[2 max]***
Accept any one of the following: ice/low temperatures/smoking/drying/pickling/jam/preserve/canning/alcohol.

(c)

	energy sources	***carbon sources***
chemoautotrophs	chemical (to generate ATP)	inorganic substances/CO_2;
photoheterotrophs	light (to generate ATP)	organic compounds;
chemoheterotrophs	chemical (to generate ATP)	organic compounds;

[3]

Do not accept "from other organisms" instead of "organic compounds".
*Award **[1]** for any two correctly identified sources.*

F3. *control by irradiation*:

a. irradiation/gamma radiation kills many pathogens/microbes/bacteria;
b. useful for sterilizing foods/medical equipment/apparatus;
c. forms free radicals / may affect flavour of food;
d. food/equipment/apparatus does not become radioactive;
e. but some people fear possible effects/reluctant to buy (irradiated food);

control by antiseptics:

f. kill microbes/prevent microbial growth on surface of tissues/wounds / prevent infection;
g. not very toxic to (living) tissue;
h. cannot be taken internally / not used on foods;
i. unpleasant taste; ***[6 max]***

*Award **[4 max]** if only one method of control evaluated.*

Option G — Ecology and conservation

G1. (a) (i) *P. ferrugineus* ***[1]***

(ii) *A. chiapensis* ***[1]***

(b) 64 % *(no working required) (accept answers in the range of 63 % to 65 %)* ***[1]***

(c) (i) more (extrafloral nectar for) food / thorns for protection/habitat ***[1]***

(ii) more protection from herbivores/parasitic ants ***[1]***

(d) a. mutualistic and parasitic species compete/are in competition / more mutualistic means fewer parasitic/inverse relationship;
b. mutualistic species more successful/have a greater presence than parasitic species on the *Acacia* species with more thorns and extrafloral nectar;
c. parasitic species most common on the *Acacia* species with fewer thorns and extrafloral nectar (particularly on *A. chiapensis*); ***[2 max]***

Do not accept answers stating numerical values alone.

G2. (a) a. few colonizing species establish themselves in harsh conditions/volcanic ash/ sand/areas devoided of life/bare rock;
b. *e.g.* moss/lichens/marram grass/bacteria;
c. more organic material accumulates/soil develops;
d. increasing species diversity; ***[2 max]***

(b) a. capture-mark-release-recapture / *OWTTE*;
b. mice are trapped in a given area, counted, marked and released (without damage);
c. a second capture is made in the same area and marked and unmarked mice counted;
d. use of Lincoln index / $\frac{n_1 \times n_2}{n_3}$; *(accept valid alternatives for equation)*
e. assumes marked mice randomly distributed / other valid comment on limitations; ***[3 max]***

(c) (i) name of invasive alien species <u>and</u> impact ***[1]***

e.g.:
water hyacinth is an invasive plant with explosive growth that blocks waterways/kills other aquatic organisms

(ii) example of biological control organism ***[1]***

e.g.:
weevils/moths/fungus/mites have been used to control the water hyacinth growth

Do not award the mark if the example of the control does not correspond to the species named in (c)(i).

G3. *indicator species*:

a. indicator species are sensitive to/need specific environmental conditions/have specific/limited range of tolerance;
b. their population growth/disappearance/reduction indicates specific changes in the environment;
c. example of indicator species and what it indicates; *(e.g. decrease in the population of stonefly larvae indicates increasing pollution levels/dissolved oxygen loss)*

Allow any other example.

biotic index:

d. compares the relative frequency of indicator species;
e. can be calculated for overall environmental assessment of an ecosystem;
f. multiply number of individuals of each indicator species by its pollution tolerance rating;
g. an abundance of intolerant species gives a high score / *vice versa*;
h. indicating an unpolluted environment / *vice versa*;
i. a change in the biotic index over time indicates a change in environmental conditions; ***[6 max]***

*Award **[4 max]** if only indicator species or biotic indices are addressed.*

Option H — Further human physiology

H1. (a) CHF without anemia ***[1]***

(b) $9\,ng\,cm^{-3}$ { *(calculation not required, accept answers in the range of 8.5 ng cm^{-3} to 9.2 ng cm^{-3})* ***[1]***

(c) a. median of CHF without anemia greater than median of CHF with anemia;
b. median of CHF without anemia similar to median of control;
c. median of CHF with anemia lower than median of control;
d. anemia (with CFH) appears to be more significant than CHF (without anemia) in affecting hepcidin concentrations;
e. difficult to determine as overlaps of ranges/population sizes not given/no control with anemia; ***[3 max]***

(d) a. low hepcidin levels in CFH patients with anemia;
b. low hepcidin allows more iron intake/absorption;
c. more iron allows more hemoglobin so less anemia / low iron leads to anemia;
d. low iron levels exert negative feedback on hepcidin production; ***[2 max]***

H2. (a) (i) estrogen / testosterone / progesterone ***[1]***
Accept other verifiable examples.

(ii) thyroxine/thyroid hormones / epinephrine / adrenaline / noradrenaline ***[1]***
Accept other verifiable examples.

(b) a. gastrin is secreted when food is in the stomach/chemoreceptors/stretch receptors are stimulated;
b. stimulates gastric acid/pepsinogen production;
c. when pH drops too low, gastrin secretion is inhibited by (secretin and somatostatin) hormones; ***[2 max]***

(c) a. exercise uses energy/ATP/increases metabolic rate/aerobic respiration;
b. which causes increased CO_2 which lowers blood pH;
c. detected by chemosensors in aorta/carotid arteries;
d. stimulate medulla/breathing centre of brain;
e. nerve impulses to diaphragm and intercostal muscles increase contraction (rate); ***[3 max]***

H3. a. absorption occurs through epithelial cells on villi/tiny projections;
b. microvilli/brush border on cell membrane increase surface area;
c. tight junctions prevent leakage of nutrients;
d. lipids/fat soluble/non-polar substances diffuse across membranes;
e. converted into tryglicerides / coated with proteins to form chylomicrons/lipoproteins;
f. which enter into lacteals/lymphatic system by exocytosis;
g. fructose/hydrophilic food enters by facilitated diffusion/through channel proteins;
h. active transport requires ATP (from many mitochondria in cells) / against concentration gradient through pump proteins;
j. *e.g.* glucose/amino acids/minerals enter through co-transported sodium carriers;
k. endocytosis of large molecules (*e.g.* vitamin B12) / pinocytosis of liquids;
l. capillaries (close to epithelial cells) transport substances (to body via bloodstream); ***[6 max]***